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Student phones and laptops as probable sources of community-acquired infections

Abstract

There is a growing trend of rightfully promoting the incorporation of information and communication technology (ICT) in school curriculums. This has increased the use of electronic gadgets like mobile phones, tablets and laptops in student lives. Despite innumerable benefits, these devices can act as infection-vectors, posing serious risk to public health in the form of community-acquired infections. This cross-sectional study was aimed at inspecting microbial presence on mobile phones and laptops of on International Baccalaureate Diploma Program (IBDP) students. Further, the sanitizing effect of simple wipe with alcohol swab was tested, as a probable preventive intervention. Samples were taken from mobile phones and laptops of IBDP students and inoculated on nutrient agar Petri plated. Each gadget was wiped with alcohol swab, and second samples were taken. Petri plates were incubated at room temperature for two weeks. Colonies were observed and count, color and regularity were noted. Gram staining was done for preliminary identification. All test samples presented a substantial growth of bacterial (and rarely, fungal) colonies. Observational analysis of laptop and mobile phone samples indicated different sizes and textures of colonies with colors ranging from red, orange and yellow, to black, grey and white. Gram staining indicated mostly gram negative streptococci, with some gram-positive cocci and some filamentous organisms. There was a noticeable 78.2% and 87.3% ($p<0.05$) reduction in colony counts after wiping the laptops and mobile phones, respectively. The pathogenic nature of these organisms and their correlation with absenteeism of students, need to be explored. Vital contributions have made the use of ICT, inevitable. These gadgets are reservoirs of microbes and mandate hygiene practices. Public awareness is crucial to minimize risk of community-acquired infection.

Keywords: microbes, electronics, college students, cell phones, notebooks, infection, absenteeism

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Abbreviations: ICT, information and communication technology; CAI, community-acquired infection; IBDP, international baccalaureate diploma program

Introduction

Germs are present everywhere. Microscopic organisms colonize both animate and inanimate surfaces. Just like everyone has a unique micro flora, every surface also has a characteristic micro biome. Gut flora is different from skin; facial flora is different from that on the hand, and so on. The relationship of these microscopic creatures with their hosts range from mutuality-symbiotic to competitive-antibiotic. On one hand, they assure optimum health by preventing infections and participating in vital functions like producing vitamin-K in gut. On the other hand, however, cross contamination from one site to the other, could have deleterious health consequences in the form of serious infection. Electronic gadgets like mobile and immobile phones, laptops and desktops have integrated into our lives. Wireless internet with third and fourth generation network connections has improved communication and connectivity, rendering these devices indispensable. With this convenience, we seem to neglect that these appliances can act as infection reservoirs thereby posing serious health hazards. While laptops are mostly in contact with our hands, mobile phones touch our cheeks, ears and even lips making microbial transmission very convenient. This is critical in academic context, because, unlike nine-to-five office jobs, students tend to work all day and sometimes even overnight. They are inclined to eat during study whereby food particles gather on laptop keyboards. Students use their mobile phones in laboratories for recording experiments and/or calculating results; they are also very likely to use phones in restrooms. Over time, these electronics become a primary hub of microbial infestation.

When laptops and phones heat up, they expedite microbial growth, transforming the seemingly passive reservoirs, to active colonies that may potentially be pathogenic. These apparently harmless practices (of using electronics while eating, or in the restroom, or in labs with potential hazard), become harmful when phones and laptops are not cleaned. Ignoring prospective risks could translate to community-acquired infections (CAI), posing serious public health implications.[1] Paper currency has a lot of microbes[2] that may root CAI. In terms of hospital-acquired infections, research explores bacterial presence on phones and desktop-keyboards of health care workers: nurses, physicians, interns, medical students, trainees and volunteers. We were specifically interested in school-going teenagers-what are their usual habits and how contaminated their phones and laptops are? Could they pose immediate serious health risks, in terms of absenteeism in school, or long-term risk in terms of probable CAI? The aim of this pilot research was to see how dirty (if at all), are the laptops and mobile phones of high-school students. This has never been reported before (to the best of our knowledge).

Methods

This cross-sectional study was conducted at Beacon house School System, Karachi, Pakistan, and involved International Baccalaureate Diploma (IBDP) Students. Risk assessment was done and ethical approval was taken from the school board. After obtaining informed consent, samples were collected from laptops-keypad and mobile-phone-fronts using sterile cotton swab. Then these surfaces were wiped with commercially available alcohol swabs and second samples were collected in the same manner. After spreading them on nutrient agar petri plates, they were kept at room temperature for two weeks. Experiment was conducted in a Biosafety level-one environment, in triplets, to assure reproducibility. Colony count was recorded, morphology was observed, and gram staining[3] was done for preliminary identification. Briefly, samples were taken from each colony using sterile wire loop. This was spread over the slide, as a thin film and fixed by passing over a flame. Crystal violet was added over the slide (30-60sec.) to stain the gram-positive. After washing with tap water iodine was added (60sec.) to fix the stain. Excess stain was decolorized with alcohol (20-30sec.) and then safranin was added (30-60sec.) to stain the gram-negative bacteria. After washing with tap water, the slides were allowed to dry and observed under microscope after covering. Paired t-test was used to test the difference in colony number before and after the wipe. P-value<0.05 was considered statistically significant.

Results and discussion

Interesting arrangements of colorful colonies appeared in all samples (Figure 1). Different sizes and shapes of red, orange, yellow, white, grey and black colonies were observed. Gram staining demonstrated most bacteria to be gram negative, with only a few gram-positive clusters. These were streptococci, rods and filamentous bacteria. Inference about probable pathogenesis mandates further testing, but suffices to say that the wide array of microbes was astonishing. Some colonies seemed to be fungal rather than bacterial. These were the preliminary results providing the base of a bigger project, where samples from multiple schools, and students of different ages and health status, can be evaluated. Although colonies obtained from the phone of one participant, match the colonies from his/her laptop, but the number and diversity of microbes from mobile phones was greater than that of laptops. This may be because students use mobile phones, much more than their laptops. One can expect somewhat opposite results in office-based environments, where laptops (and probably desk phones) are used more than mobile phones. Essentially, after alcohol wipes, the number of colonies reduced to 78.2% and 87.3% ($p<0.05$) in laptops and mobile phones respectively. This is huge, because a single wipe can prove effective in preventing CAI in long term.

To the best of our knowledge this is the first formal report on laptops and mobile phones of IBDP teenagers. We report the presence of a wide variety of gram negative streptococci, rods and filamentous bacteria with rare appearance of gram positive bacteria and some fungal colonies. We further presented a remarkable elimination of a majority of these microbes with the use of simple alcohol swabs. Our findings are in line with others, reporting similar microbial presence on phones of students at the University of Cape Coast Ghana,[4] Medical staff from Queen Elizabeth Hospital,[5] health care professionals from Turkey,[6] Iran,[7] Nigeria[8] and India.[9] But most of these were hospital associated institutions. We emphasize the risk to general public and high-school students, because youth makes-up more than 65% of the world's population. A study from Saudi Arabia[10] recommends restriction of cell phones' usage during hospital hours. We discourage any such intervention and deem it impractical. The imperative contributions of these technologies have made them essential. Education systems focused on globalization and international mindedness, mandate the use of wireless internet. The wide-held emphasis on ICT, and reinforcement of a paper-free, environment-friendly culture, obligate the use of laptops in classrooms. We emphasize on educational campaigns and public awareness sessions to ensure good practices, including regular cleaning of electronic appliances and hand-washing before and after their use. Like any preliminary research this study was also not free from limitations. The current investigation was merely a cross sectional analysis of students, and may be imperiled by volunteer bias. The correlation of germs with frequency of absenteeism among school children needs to be explored for credible causative role of these contraptions as infection vehicles. Precise identification of these microbes and allied pathogenicity and antibiotic resistance are absolutely essential, to draw any conclusions at community level.[11] Further there is a prerequisite for large scale, long term intervention studies to evaluate the effectiveness of preventive strategies.

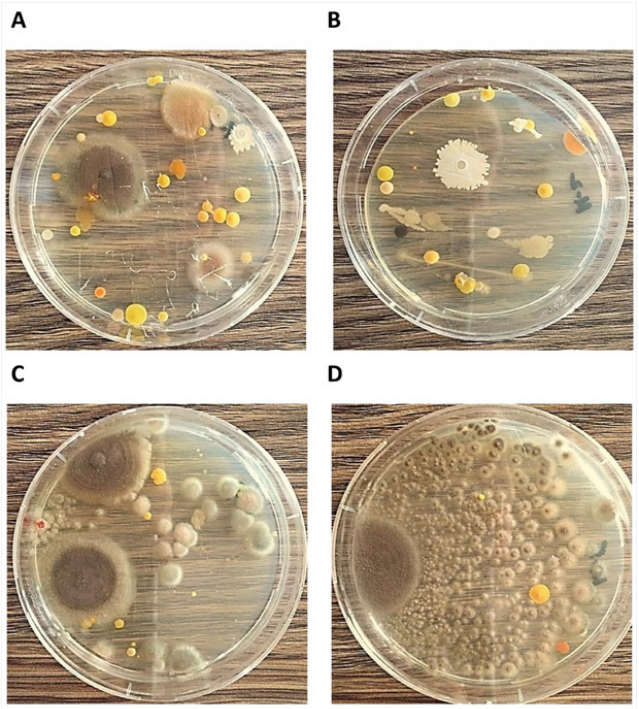

Figure 1 Representative microbial colonies from students' laptop (A and B) and mobile phone (C and D) samples.

Conclusion

This is the first study showing microbial growth on cell phones and laptops of high-school students. Gram staining had indicated the dominating presence of gram-negative streptococci, with some filamentous bacteria. It was surprising to find such a variety of microscopic life forms on these gadgets. While most of these could just be the normal flora of the human body surfaces (like palm, finger and cheek) that are in contact with phones and laptops, there is still a good chance that some of these organisms might even be pathogenic. With a high reproduction rate mutations are likely to develop, which

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could cause infections in students. This research needs further exploration through larger long-term studies. With the ever-increasing acceptance of technological advancements, we need to make sure that the general public is aware of the probable unexpected health consequences. Adopting simple measure-like frequently wiping gadgets with alcohol swabs, avoiding meals while working on laptops and using hand-sanitizers before and after meals– can improve public health by limiting any unforeseen complications.

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Approval and consent

Safety of the study procedure was assessed by the school heads and Ethical Approval was obtained after clearance. All participants signed informed consents, a copy of which was provided for their record.

Conflict of interest

Author declares that there is no conflict of interest

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